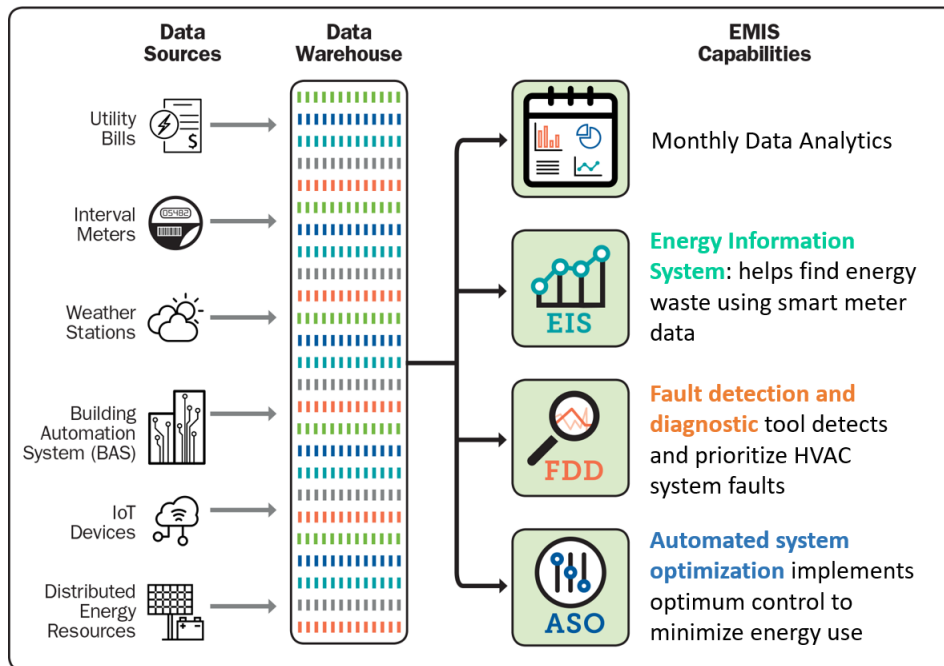


Building Analytics: They say it works, but will it work for ME?

Guanjing Lin (Lawrence Berkeley National Lab)

Background

Energy Management and Information System
(EMIS) Overview



We've developed **standardized EMIS Field Validation protocol** for validating energy and non-energy benefits!

EMIS field validation projects growing, but...

...no **standardized** way to assess benefits

Studies conducted in different ways

Hard to generalize from inconsistent data sets

Risk aversion slows adoption

Technical Approach

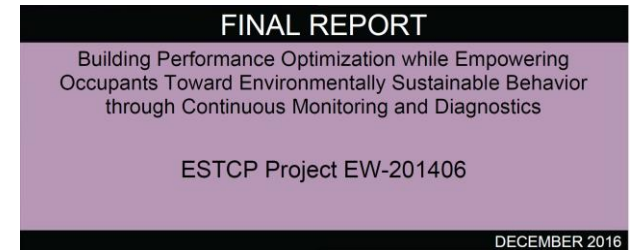
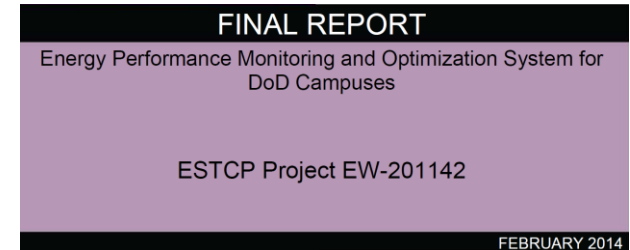


EMIS Field Validation Protocol development process:

- Literature review and stakeholder interviews to understand key metrics and priorities
- Draft Protocol development
- Field demonstration support and feedback
- Finalize and publish Protocol
- Publish sample EMIS field evaluation results to public repository

EMIS Protocol elements incorporated into ongoing field demonstrations:

- U.S. Department of Defense Environmental Security Technology Certification Program
- U.S. Department of Energy Grid-Interactive Efficient Building Field Validation Program
- U.S. General Services Administration Proving Ground Program



Results to Date

Draft EMIS Field Validation Protocol:

- Introduction
- Overview of EMIS field evaluation
- EMIS field evaluation plan
- Field evaluation parameters and approaches
- Appendices

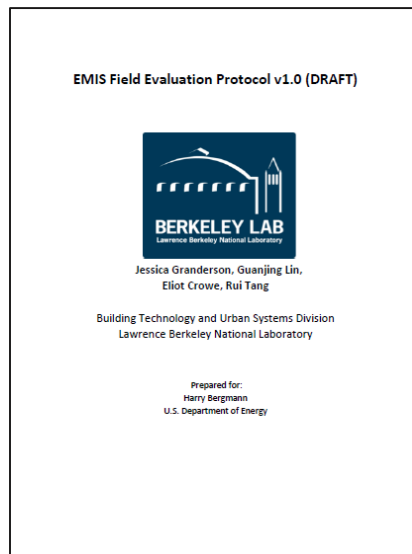


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Results to Date



- Create standardized reporting template to capture essential information identified in EMIS field validation results

Building description

| Building description | |
|--|--------------------------------------|
| Building name | |
| Building location_City | |
| Building location_State | |
| Building location_Climate Zone | |
| Building type | |
| Building area | sq.ft |
| Occupied Schedule Day | |
| Occupied Day Start Time | |
| Occupied Day End Time | |
| Building Automation System_Model | |
| Building Automation System_Make | |
| Which of the following building systems and equipment are covered by EMIS? | |
| HVAC system | Metering system |
| Central cooling plant | |
| Central heating plant | |
| Air handler unit | |
| Rooftop unit | |
| Terminal units | |
| Chiller | |
| Boiler | |
| Cooling tower | |
| Pump | |
| Fan | |
| | Lighting system |
| | |
| | Plug load system |
| | |
| | Other system, please describe |
| | |

Technology description

| Technology description | | | |
|---|---|--|---|
| EMIS name | | | |
| EMIS vendor name | | | |
| Which of the following data points are integrated into the EMIS? Select Yes for all that apply | | | |
| Interval energy and power meter data | HVAC system trend data | IoT sensor data | Lighting control system trend data |
| Whole building electricity meter | Central cooling plant trend data | IoT temperature sensor data | Plug load control system trend data |
| Whole building gas meter | Central heating plant trend data | IoT humidity sensor data | Others system trend data, please describe |
| Whole building water meter | Air handler unit trend data | IoT occupancy sensor data | |
| Electric submeter - for tenants | Rooftop unit trend data | IoT carbon dioxide sensor data | |
| Electric submeter - for end uses | Terminal units and thermostat trend data | Other IoT sensor data, please describe | |
| Chilled water BTU meter | Other HVAC system trend data, please describe | | |
| Hot water BTU meter | | | |
| Steammass flow meter | | | |
| Other energy and power meter data, please describe | | | |
| Which of the following functionalities and capabilities do the EMIS have? Select Yes for all that apply | | | |
| Energy Information System | Fault detection and diagnostics | Automated system optimization | |
| Energy consumption(costs) visualization | Fault detection and diagnostics | System/equipment on/off schedule | |
| EIS performance indicator (KPI) tracking | Operational data visualization | Control cooling plant chilled water leaving temperature setpoint | |
| Energy performance analysis | FDD key performance indicator (KPI) tracking | Control cooling plant cooling tower leaving temperature setpoint | |
| Demand management | Fault prioritization | Control cooling plant hydronic differential pressure setpoint | |
| Measurement and verification | Fault reporting and data export | Control cooling plant chiller/pump/cooling tower staging | |
| Energy reporting and data export | Other FDD capabilities, please describe | Control heating plant chilled water leaving temperature setpoint | |
| Other EIS capabilities, please describe | | Control heating plant hydronic differential pressure setpoint | |
| | | Control heating plant boiler/pump staging | |
| | | AHU/RTU supply air temperature setpoint | |
| | | AHU/RTU supply air static pressure setpoint | |
| | | Space heating and cooling setpoints | |

- Fill in evaluation results in yellow highlighted cells (Red font is required field)

Results to Date



- Create standardized reporting template to capture essential information identified in EMIS field validation results

Energy and utility cost

| | |
|--|-----------|
| Baseline period_Start date | |
| Baseline period_End date | |
| Reporting period_Start date | |
| Reporting period_End date | |
| Savings calculation approach (IPMVP option) | |
| Annual energy savings_kBtu | kBtu |
| Annual energy savings_Percentage | % |
| Annual energy savings_Intensity | kBtu/sqft |
| Annual energy cost savings | \$ |
| Monthly non-coincident peak demand reduction | kW |
| Monthly coincident peak demand reduction | kW |
| Demand response load reduction | kW |

Capability to enable energy efficiency

Please enter the number of efficiency measures implemented in which your EMIS supported identification or resolution.

| | Improve scheduling | Improve economizer operation/use | Reduce over-ventilation | Reduce simultaneous heating and cooling | Tune control loops to avoid hunting | Optimize equipment staging | Zone rebalancing | Adjustment of heating/cooling and occupied/unoccupied space temperature setpoints | Reduction of VAV box minimum setpoint | Duct static pressure setpoint change | Hydronic differential pressure setpoint change | Preheat temperature setpoint change | Supply air temperature reset | Duct static pressure reset | Chilled water supply temperature reset | Hot water supply temperature reset or hot water plant lockout | Condenser water supply temperature reset | Add or optimize variable frequency drives (VFDs) | Pump discharge throttled or over-pumping and low delta T | Routinely share energy information or guidance on proper use of equipment with occupants through EMIS technology. | Hold an energy savings challenge using EMIS data. | Lighting upgrade or improve lighting controls | High efficiency HVAC equipment: Airside | High efficiency HVAC equipment: Waterside | Others |
|---|--------------------|----------------------------------|-------------------------|---|-------------------------------------|----------------------------|------------------|---|---------------------------------------|--------------------------------------|--|-------------------------------------|------------------------------|----------------------------|--|---|--|--|--|---|---|---|---|---|--------|
| HVAC system | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lighting system | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plug load system | | | | | | | | | | | | | | | | | | | | | | | | | |
| Central cooling plant | | | | | | | | | | | | | | | | | | | | | | | | | |
| Central heating plant | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air handler unit | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rooftop unit | | | | | | | | | | | | | | | | | | | | | | | | | |
| Terminal units | | | | | | | | | | | | | | | | | | | | | | | | | |
| Occupants | | | | | | | | | | | | | | | | | | | | | | | | | |
| If "Other" is marked above, please describe the component and efficiency measures | | | | | | | | | | | | | | | | | | | | | | | | | |
| Components | Measures | | | | | | | | | | | | | | | | | | | | | | | | |

EMIS Costs

| | | | | | | |
|---|---|---|---|---|---|---|
| EMIS implementation costs | = | Base costs for EMIS technology | + | In-house labor costs for EMIS installation and corr | = | EMIS implementation costs |
| | | \$ | | \$ | | \$ |
| Ongoing annual EMIS operating costs | = | Annual costs for EMIS technology | + | Annual in-house labor costs for EMIS use | = | Ongoing annual EMIS operating costs |
| | | \$ | | \$ | | \$ |
| EMIS implementation costs_Intensity | = | Base costs for EMIS technology_Intensit | + | In-house labor costs for EMIS installation and corr | = | EMIS implementation costs_Intensity |
| | | \$/sqft | | \$/sqft | | \$/sqft |
| Ongoing annual EMIS operating costs_Inten | = | Annual costs for EMIS technology_Inten | + | Annual in-house labor costs for EMIS use_Intensity | = | Ongoing annual EMIS operating costs_Intensity |
| | | \$/sqft | | \$/sqft | | \$/sqft |

Cost-Effectiveness

| | |
|-----------------------------|------|
| Simple payback | Year |
| Net present value | \$ |
| Savings-to-investment ratio | |

Evaluation Results

Conclusions and Next Steps



Conclusions

- In Spring 2020, LBNL developed a standardized protocol for assessing the energy and non-energy benefits of EMIS
- Primary target audience - evaluators of federal or state-sponsored emerging technology programs, utility emerging technology programs, owners of large building portfolios, and research organizations
- A minimum set of standardized metrics and additional optional metrics
- Balancing high rigor in assessment method vs. allowing flexibility

Next steps:

- Field Test Demonstrations due to complete by 6/30/21
- Final Protocol to be published by 9/30/21



Additional Resources:

For more details of Berkeley Lab's research on energy management and information systems (EMIS), visit: <https://buildings.lbl.gov/emis/building-energy-information-systems>

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